

The brightness at the time of its discovery has been taken as unity. At the time of the last observation the computed intensity was $I=0.3$, when it was a difficult object in the 15-inch Refractor of Harvard College Observatory. Its rediscovery may therefore be expected if it passes its perihelion between September and April.

Notes on some Star Photographs recently taken at Sydney Observatory. No. 2. By H. C. Russell, B.A., F.R.S., Government Astronomer.

It will be remembered that in the November number of the *Monthly Notices* I gave an account of the Milky Way about η Argus, and stated that the photograph was *under-exposed*. On several occasions since I have tried longer exposures with the same camera and plates (Ilford Extra Rapid), getting better results as the time of exposure increased.

I have at last got an exposure of eight hours on a fine clear night, and this makes the whole aspect of this part of the Milky Way so different that I send glass and paper positives of it, which should be compared with those sent before to fully realise the enormous difference which the increased exposure and clearer night have made. In comparing the plates it is necessary to remember that the camera slide has been turned 90° , and, therefore, the long way of the plate is now north and south.

I have not attempted as yet a general count of the two photographs, but there is obviously a great number of additional stars, and hence it is not to be wondered at that the whole aspect of the Milky Way about η Argus appears changed, and at the same time it is satisfactory to note that little details, dark spots and lines, visible in the fainter negative are reproduced in this; the nebula itself is much brighter, and the details more defined, the outlying wreaths of nebula extending over a much wider space than has appeared in any drawing or previous photograph. This feature is best seen in the paper print of this object made from the *portrait camera negative* No. 81, which was exposed eight hours. In that photograph the great rift which divides the nebula seems to originate in an oval dark space and passes thence upwards and towards the preceding side, passing first between two well-marked clusters of stars; thence it passes another cluster on the left, and at the third cluster it turns away to the left; it is quite evident also that the nebulous matter here is bounded by this dark rift, and includes the middle cluster on the left, which is an extension in this direction four times as far as Herschel traced it with his reflector at the Cape. Starting again from the rift near the dark oval and going south, the nebula is extended nearly as far again as Herschel saw it, and

the parallel curved wreaths of nebula are much more distinct than in my earlier photographs, but still seem to want longer exposure.

In the dark oval space which lies near the southern extremity of the nebula no increase of exposure suffices to show any nebulous light whatever.

I have also made a number of long exposures on η *Argûs* with the "Star Camera" (11 feet $3\frac{1}{2}$ inches focus), and succeeded, as the accompanying glass and paper prints will show, in proving that the central part of the nebula about this star has a most complex structure, of the same character as that about θ *Orionis*; but although the greater space given to the nebula in this camera makes the separation of these details possible, I have not yet succeeded in getting so dense and extended a picture of it as I get with the portrait camera, although I have tried one American and another English make of plates; indeed, neither of these makers' plates, judged by the sample I have received, is so sensitive as that which I have been using.

I have compared the plates by having the two cameras side by side on the same stand and pointing to the same place, and then with plates to be compared one in each camera, giving them the same exposure; I had first determined by many trials that the two cameras are about equally powerful.

In the contact print from negative No. 77 it will be seen that the nebula extends but little beyond the well-known oval in the south of it, while in the prints from the portrait camera negative No. 81 the nebula may be seen to extend much farther, and the extension along the great rift spoken of as visible in the photographs from the portrait camera is not to be traced here, but the great dark oval not noticed by Herschel appears very conspicuously in a number of the photographs that I have taken, and must be a feature of the object; it is near the centre of the whole nebula and at the end of the great rift.

It was in this dark oval space that one of the brightest and most conspicuous parts of the nebula was situated when Herschel was at the Cape, and the fact that it has wholly disappeared is a significant commentary on the wisdom of the course which he adopted, in not only drawing but in marking out by conspicuous stars, and by descriptive letter-press, portions of the nebula which were well defined and conspicuous.

The part of the nebula referred to was situated about the intersection of the lines $+50^s$ and $+3000$, and in studying and re-mapping this nebula in 1871 I noticed that this portion was missing. I called attention to it then, but as the telescope I used was of only $7\frac{1}{4}$ inch aperture it could hardly be assumed as proven. Later I failed to find it with the $11\frac{1}{2}$ -inch refractor, and it is still invisible in the best of my photographs, which show fainter nebulae and hosts of stars which Herschel could not see. It is in many respects the most remarkable part of Herschel's drawing, and at p. 39 of the letter-press, after

pointing out the care he had bestowed in laying down parts of the nebula which were well defined by carefully measuring stars situated on or about their edges, and which was done with the expressed object of detecting any change in the nebula, or, to use his own words, "will serve as excellent detectors of change in its form should any occur;" and again, "so situated that the slightest shifting of the nebulous contour at its preceding side cannot fail to be rendered visible;" and then referring to one conspicuous point of the now missing part, he says, "Similarly the star O, No. 803, and O₁, No. 813, one on each side of the remarkable nebulous projection whose co-ordinates $+25^{\circ}$ and $*-2500$ pts. afford means of ascertaining any relative movement in this part of it." In other parts of this great nebula these descriptive paragraphs accurately describe the features as they are to-day; and even here the stars are visible, but in the part under discussion there is no such nebula as he describes, either with our equatoreal of $11\frac{1}{2}$ inch aperture, or in these photographs. As a means of estimating how much more powerful in grasping faint objects these photographs are than Herschel's large reflector, I may mention that he carefully scanned the great oval in the southern part of the nebula, and records that he saw four very faint stars in it. My negative, No. 77, shows twenty stars in the same space, and in the lemniscate which attracted his very close attention, and where he saw *one star*, my negative shows ten stars. We have here, therefore, the strongest evidence that a well-defined and brilliant portion of the nebula about η Argus has disappeared between the years 1837 and 1871, when I first noticed that it was gone.

During March 1891 I have taken photographs with a view of tracing the Milky Way in the great rift which Herschel shows right across it in *Argo*, and here, as I have found in other parts, the eye and the camera differ very much.

It will be seen that the three photographs sent (paper and glass positives of each herewith) cover most of the rift in question, and the rough diagram sent herewith of the Milky Way, on the same scale as the photographs copied from Herschel and Proctor, will make the comparison easier. On it the spaces covered by the plates are marked in red ink, and the scales of the photographs and diagram are roughly the same.

The centre of plate 65 is in the preceding point of the four remarkable projections of the Milky Way; its centre is in R.A. $7^{\text{h}} 50^{\text{m}}$, and Dec. $47^{\circ} 47'$, and it covers from Dec. $40\frac{1}{2}^{\circ}$ to 54° , thus taking in at least 4° beyond the remarkable point in the drawings, and it is covered with stars almost uniformly, although the eye sees no Milky Way in that part of the sky covered by the southern end of this plate; or, in other words, the Milky Way here, as seen by the camera, extends right across the rift which to the eye appears void of stars. Similarly plate 73 shows the stars almost uniformly over the plate which here

* This is a misprint; the sign should be +. See position of stars.

covers not only the Milky Way space but the whole of the great rift between R.A. $8^h 10^m$ and $9^h 10^m$, or, in other words, completely across the rift shown in the best drawings. The centre of No. 73 is in R.A. $8^h 37^m$ and Dec. $46^\circ 53'$ S., and it extends from 40° to 54° S. Dec., and taking this with No. 65, the whole of the rift from $7^h 20^m$ to $9^h 10^m$ is found to be as thickly studded with stars and star-dust as the neighbouring parts figured on the best star maps. By comparing the overlapping parts of Nos. 65 and 73 it will be seen that 73 does not show quite so many stars as it should, the night it was taken not being so clear as the night on which No. 65 was taken. Plate No. 68, again, shows a band of stars extending completely across the rift from R.A. $10^h 10^m$ to R.A. $10^h 30^m$. The night when this plate was taken was not a very good one, and hence probably here also the stars are not so numerous as they ought to be. On February 9, 1891, the night being very clear, a negative of *Nubecula Major* about 30 *Doradus*, with $6^h 17^m$ exposure, was taken with the Star Camera, 11 feet $3\frac{1}{2}$ inches focus. In this negative the central part of the nebula is over-exposed, but the surroundings show out faintly as a most complex structure, and are fairly reproduced in the thin contact print No. 2; their extent is at least eight times as great as that which the central mass covers when seen through the telescope. These faint outlying portions are of the same character as the parts visible to the eye; that is, a series of loops arranged symmetrically with regard to the central mass: the greatest extension is on the preceding side, where it stretches out nearly three times the width of the part seen with the telescope, and on the south side there can be traced very faintly a large oval dark space outlined by the nebula and as long as the whole of the central mass.

In No. 1 these features of the nebula have been sacrificed to make the stars bright on a black ground. The arrangement of the stars here is most unusual; the great groups are very concentrated, without any signs of spiral structure, and these clusters, all of which are elongated, are roughly parallel with each other, and separated by dark bands, which, however, are not without stars. I have not seen a similar structure in any other part of the heavens, and the stars are much closer together than usual. In places they number at the rate of 5,000 or 6,000 to a square degree, so that it is not surprising to find the dense parts run into blotches of light when photographed with the portrait camera.

On these Star Camera plates $1^\circ = 2^m.360$, and on those taken with the portrait camera $1^\circ = 0^m.556$.

The photographs are placed in the Library.

Examples of Comparative Photographs of the Metallic and Solar Spectra. By F. McClean, M.A.

The photographs represent the spectra of Sections IV., V., and VI. of the Gold Group of Metals and of Section IV. of the Iron Group. These spectra are collated by means of their common air lines with the iron spectrum, and so by means of the iron lines with the solar spectrum.

The sections correspond with the divisions of Ångström's Chart. Section VI. extends to wave-length 5720 (a little short of D), which is as far towards the Red as the photographs can be, at present, satisfactorily obtained. The exposure requisite with the more refractory metals is something like sixty times as long as is necessary for photographs of the corresponding portions of the solar spectrum, although an extremely powerful induction spark is used.

These photographs are probably among those which offer the greatest difficulty in the series of metallic spectra now in hand, and as the undertaking is one requiring considerable time and labour, I wished meanwhile to bring these examples of the work before the Society.

The spectra of the metals appear to me to be fairly within the scope of astronomy, as our knowledge of them forms the basis of any knowledge we possess of the composition of the heavenly bodies.

The spectra of the Gold Group, as far as the photographs go, indicate many lines due to these metals not hitherto observed, and they also show some curious coincidences between the air lines in the metallic spectra and lines in the solar spectrum.

1891 June 11.

Observations of the Partial Solar Eclipse of 1891 June 6, made at the Radcliffe Observatory, Oxford.

(Communicated by E. J. Stone, M.A., F.R.S.)

The observations of first contact were lost owing to cloud. The last contact was satisfactorily observed.

Greenwich Mean Time.	Observer.	Instrument.	Power.	Ref.
$\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 6 & 22 & 46\cdot4 \end{smallmatrix}$	Wickham	Barclay, 10-inch	90	(a)
$\begin{smallmatrix} \text{h} & \text{m} & \text{s} \\ 6 & 22 & 47\cdot8 \end{smallmatrix}$	Robinson	Helimeter, $7\frac{1}{2}$ -inch	140	(b)

(a) The time given is that of the last trace of the Moon's limb: phenomenon slow, limbs undulating, but observation good.

(b) The time noted is that of the final disappearance of the Moon's limb; observation considered very fair.

Radcliffe Observatory, Oxford:
1891 June 11.